

CHAPTER A

TABLE OF CONTENTS

A.00	General
A.01	Definitions
A.02	Maintenance Levels
A.03	Policy for Performing Roadbed Maintenance Work
A.04	Surface Types
A.05	Types of Flexible Roadbed Failures
A.06	Stockpile Materials for Patching Bituminous Surfacing
A.07	Asphalt Concrete Pavement
A.08	Surface Repairs of Oiled Earth, Gravel or Earth Surfaces
A.09	Base Repairs
A.10	Surface Repairs of Flexible Pavement
A.11	Pothole and Other Small Patches
A.12	Extensive Surface Repairs and Major Maintenance Blankets
A.13	Surface Corrugations
A.14	Heat Treatment
A.15	Seal Coats
A.16	Preparation Prior to Applying Seal Coats
A.17	Types of Seal Coats
A.18	Spreading Cover Material Over Seal Coats
A.19	Flexible Pavement Joint and Crack Sealing
A.20	Work on Asphalt Shoulders
A.21	Road Approaches to Public Roads
A.22	Bicyclists on State Highways

A.00 General

This chapter contains information relevant to the "A" Family, Flexible Roadbed.

A complete description of all activities included in this "family" is contained in Volume 2 of the Maintenance Manual.

A.01 Definitions

Maintenance of the traveled way covers the repair of both surface and base of the roadway within right-of-way lines that is for the movement of vehicles. It includes the area between the inside of curbs where curbs exist, county road approaches, and city street intersections between right of way lines.

Maintenance work can be defined as that work, either by contract or by State forces preserves the riding qualities, safety characteristics, functional serviceability and structural integrity of the facilities that comprise the roadways on the State Highway System.

A flexible roadbed is a roadbed surfaced with asphaltic concrete (AC), or a Portland cement concrete (PCC) pavement with a 2 inch (50.8 millimeters) or more asphaltic concrete surfacing overlay. Oiled earth, gravel, and earth surfaces are also included under flexible roadbed.

The roadbed is that portion of the roadway, including ramps and public road approaches, that extends from curb line to curb line or shoulder line to shoulder line, including dikes. Divided highways are considered to have two roadbeds.

A.02 Maintenance Levels

The general objectives of roadbed maintenance are to provide safety, to preserve the State's capital investment and to maintain a riding quality satisfactory to the traveling public.

Maintenance of the roadbed covers the restoration and repair of both surface and underlying layers.

Typical items to be considered in roadbed maintenance are slippery pavement, cracking, raveling, corrugations, loss of lateral support from edge of pavement, wheel grooving, potholes, settlement, heave or distortion, bridge approach settlement, base failure, drip track erosion and abrupt vertical surface differential.

Roadbed deficiencies that immediately affect safety should be given first priority in roadbed maintenance. Typical defects in this category are slippery pavement, raveling, rutting, excessive bridge approach settlement, potholes and abrupt vertical variations.

Second priority should be given to the correction of roadbed defects having a long-range effect on riding quality and capital investment. Typical examples of defects in this category are pavement cracks and pavement and surfaced shoulder distress.

The following summaries provide typical considerations in roadbed maintenance and levels of service.

(A) Slippery Pavement

- (1) Pavement surface texture is subject to adverse change as a result of aging, excess asphalt, wear, etc.
- (2) Routine surveillance of pavement texture should be made and suspected problem areas reported promptly.
- (3) Obvious slippery areas should be corrected to the extent feasible under the prevailing conditions. When additional corrective action is necessary, it should be initiated or scheduled promptly.
- (4) Suspected slippery areas should be promptly reported for further investigation.

(B) Cracks

- (1) Cracked pavement allows water and foreign material to enter the structural section and may cause ultimate failure.
- (2) Individual cracks 1/4 inch (6.35 millimeters) wide or wider and any areas with extensive finer cracking should be repaired before the rainy season to protect the structural section.

(C) Raveling

- (1) Raveling is an indication of failure of the binder or aggregate; once started it may develop quite rapidly.
- (2) Raveling should be corrected before safety is impaired or extensive pavement loss occurs.

(D) Corrugations

- (1) Corrugations are repetitive distortions of asphaltic surfacing resulting in poor riding quality.
- (2) Corrugations should be corrected before safety is impaired or extensive pavement loss occurs.

(E) Settlement, Heave and Distortion

- (1) This type of roadbed defect often results in poor riding quality, and excessive impact loading of bridges and slabs. It does not always involve failure of structural section. Typical causes are fill-settlement, unstable cuts, expansive soils, and unconsolidated basement soil.

- (2) Settlement, heave and distortion may not cause any problem at low speed but would be objectionable at high speed.
 - (3) Surface irregularities and vertical edges create a rough riding roadbed. Many irregularities are not as obvious to the driver at high speeds as they are at low speeds.
 - (4) An abrupt vertical differential between the traveled way and paved shoulder should be scheduled for repair when the riding quality is objectionable.
 - (5) Corrections for surface irregularities should be scheduled when surface deviations reach 1 1/2 inches (38 millimeters) in a length of 50 feet (15.24 meters) or when the riding quality is objectionable.
- (F) Wheel Track Rutting
 - (1) Wheel track ruts have the undesirable effect of trapping water and may cause pavement deterioration.
 - (2) Corrections should be scheduled when the groove exceeds 1 inch (25.4 millimeters) in depth from a straight edge placed at right angles to the direction of travel or when water is impounded.
- (G) Drip Track Erosion
 - (1) This is pavement erosion caused generally by crankcase drippings.
 - (2) Correction should be scheduled when the resulting erosion exceeds 1/2 inch (12.5 millimeters) when water is impounded, or when evidence indicates the binder is ineffective.
- (H) Potholes
 - (1) Potholes are subject to rapid enlargement and may result in considerable pavement loss and objectionable ride.
 - (2) Potholes should be repaired promptly.
- (I) Base Failures
 - (1) There are many degrees of base failure as evidenced by cracking or distortion in the surfacing. Many corrective measures may be applied, and ultimately the base may need replacement. Base failures considered here are those which require removal and replacement of the defective material.

- (2) When base material in localized areas becomes contaminated or broken to the extent that riding quality and structural integrity of the pavement cannot be restored by surface treatments, the defective base material should be removed and replaced. When necessary, temporary repairs should be made until permanent repairs can be scheduled.

(J) **Dikes and Berms**

- (1) Asphaltic Concrete dikes and earth berms control roadbed runoff and protect slopes from erosion. When not maintained as built, extensive damage to the roadway may result.
- (2) Damaged dikes and berms, which will allow runoff to erode the roadway, should be repaired promptly or temporary repairs made until permanent repairs can be scheduled.
- (3) Damaged dikes and berms not falling under the above category should be routinely repaired in conjunction with other maintenance operations to minimize traffic disruption.
- (4) Asphaltic Concrete dikes and penetration-treated berms in areas where asphaltic material is subject to rapid oxidation or freezing conditions should be inspected annually and sealed upon evidence of ravel cracking, or other surface deterioration.

A.03 Policy for Performing Roadbed Maintenance Work

Roadbed maintenance work can be accomplished by either contract or by State forces. This work is further subdivided into two broad categories, routine maintenance work or major maintenance work.

It is the State's policy to contract out maintenance work that lends itself to this mode whether it be major maintenance or routine maintenance. Work that is contracted out must be in full conformance with the relative provisions of the State Contract Act.

The following criteria comprise the Maintenance Program policy for the selection and use of the various strategies of maintenance that are available.

(A) **Criteria for the Use of Chip Seals**

The use of chip seals for preventive and major maintenance work shall continue in conformance with the current standard which considers speed limits, average daily traffic (ADT) and the percentage of trucks. Considering the results of last year's chip sealing programs, the 30,000 ADT will continue to be the maximum ADT allowed when speed limits are 45 mph (72.4 kilometers) or higher. Please contact the Maintenance Program for details regarding the use of lightweight aggregates for chip seals using conventional aggregates.

For emulsion chip seals at locations with ADTs of <5,000 per lane, Districts may select a maximum chip size of 3/8 inches (9.52 millimeters) medium. The maximum size of chip for all higher ADT roads will be 5/16 inches (8.0 millimeters).

For "Hot Applied" chip seals, (Polymer Modified Asphalt and Asphalt-Rubber Binders) 3/8 inch (9.52 millimeters) chips is the standard size chip to be used. For locations with ADTs of <5,000 per lane, Districts may select a maximum chip size of 1/2 inch (12.5 millimeters). Aggregate gradation for these seals shall be kept coarse to deter flushing problems caused by the high binder content and excessive fines in some designs.

In areas where there is significant wheel rutting or there are irregularities (> 1/2 inch) (12.5 millimeters), corrective action should be taken to include either placement of an AC leveling course or grinding and crack filling. The intent is to deter the flushing that often occurs in the wheel tracks or low spots caused by runoff of the binders from the higher spots to the depressions and to prevent drainage problems. Provision for fog sealing or sanding the finished chip seal will be made if bleeding or chip loss is thought to be a problem. For contracted chip seals, fog sealing and sanding (flush coats), are required for all chip seals.

Latex modifiers will be used in all emulsion chip seals. Continued experimentation is encouraged on chip seal projects to test new products and techniques to increase flexibility, resistance to flushing, better chip adhesion, reduce windshield breakage, achieve better crack filling and sealing and longer life.

(B) Criteria for the Use of Slurry Seals

The use of slurry seals, as one of the preventive maintenance strategies will be continued.

It is anticipated that specifications will be developed to include additives of polymers in all future slurry binders.

Preparatory work, including crack filling, pavement repair, and rut filling will be done in all cases prior to slurry sealing. Excessive overfilling with crack sealants shall be avoided to prevent fat spots in the slurry seal.

Slurry seal specifications have been written and are available for Districts to use as a preventative maintenance strategy when 10 percent or less alligator "B" cracking (ABC) is present.

Several Districts are placing slurry seals in areas that chip seals would not be a good choice due to high ADTs, intersections, signaled and stop areas, business areas, and areas that are heavily shaded, etc. Slurry seals can be placed in areas with pavement and ambient temperatures as low as 50° Fahrenheit (32.4° Celsius) when approved by the Pavement Branch at the Engineering Service Center (ESC). Slurry seals are not to be placed at night and by design are intended to be a single stone thick application.

When rut filling or night work or colder temperatures restrict the use of a standard slurry seal, contact the TransLab regarding the use of micro surfacing. Micro surfacing is designed for these conditions.

Continued experimentation with new equipment techniques, and additives are encouraged in attempts to improve the quality of slurry seals.

(C) Paved Shoulder Sealing

The normal treatments for paved shoulders when seal coats are being placed is as follows:

As a minimum, paved shoulders will receive a rejuvenating agent, sand seal or fog seal.

If the conditions of the paved shoulder is poor and has already had several applications of fog seal or rejuvenating agent, the shoulder will receive a chip seal or a slurry seal the same as the traveled way. When applying a slurry seal, consider the use, of a Type I or a Type II, to prevent water from being trapped at the edge line.

In those situations where traffic, weather or other special conditions require the application of open graded asphalt concrete, the application may be extended to the paved shoulder when it is 4 feet (1.22 meters) or less in width. When the shoulder is 4 feet (1.22 meters) wide or more, the open graded asphalt concrete shall be placed 1 foot (0.3048 meters) beyond the traveled way edge. The outside 6 inches (150 millimeters) of the open graded asphalt concrete will be rolled so as to produce a taper from 3/4 inches (19.05 millimeters) thick to nearly nothing.

Pavement overlays 1 inch (25.4 millimeters) thick or greater should cover the entire shoulder, regardless of the width.

In the following or comparable exceptional situations, particularly on smaller projects, it may be impractical to contract for the work. Use of Maintenance crews is permissible under the following circumstances:

- (1) The project is so affected by conditions of site or existing structure as to make it impractical to define the details of the work with sufficient accuracy to permit competitive bidding.
- (2) The work is to be done at a remote location, and contractors do not appear interested in the project. However, in general, this should be determined by advertising for bids, or by documented contact with local contractors indicating they are not interested.
- (3) Where there is an urgent need for the work to start immediately, and it is not feasible to use one of the contracting procedures involving competitive bidding.

Maintenance funds can only be legally spent for maintenance work. Reconstruction, rehabilitation and improvement work shall not be done with maintenance funds. Maintenance work can be defined as that work, either by contract or by State forces, that preserves the riding qualities, safety characteristics, functional serviceability and structural integrity of the facilities that comprise the roadways on the State highway system.

Routine maintenance work is defined as that maintenance work (at one or more locations) grouped together in projects where the total estimated project cost is less than \$24,000 and the distance between projects is at least 2 miles (3.2 kilometers). Routine maintenance work is usually done by State forces and does not require specific District Director approval.

Major maintenance projects must meet the same criteria as routine maintenance work except the estimated value of the project is over \$24,000 with no upper limit except for base surfacing repair and AC overlays which are limited to \$300,000 (per direction on divided highways). Within this limit, AC overlays are limited to 1/ 10 foot thickness (30 millimeters), with additional allowance for filling depressions and wheel ruts. The PCC slab repair/replacement limit is \$300,000 per direction on divided highways. Other types of maintenance projects are clearly maintenance work and require no monetary upper limit when done by contract. The upper monetary limits specified above the necessary to clearly label them as maintenance work, not reconstruction, rehabilitation or improvement work. Major maintenance work can be done by contract or State forces provided relative restriction on State forces work are met. When major maintenance work, is done by State forces, they are restricted to \$125,000 upper limit for all strategies.

Major maintenance work to be performed by State forces requires special designation number beginning with "MM" assigned to them and are to be reported with the applicable existing family/problem code.

Exceptions to the monetary limits require specific approval of the District Director and notification to Headquarters Maintenance.

If State forces' work costs have been underestimated and it is necessary to exceed the estimate to complete the project, specific District Director approval is required with notification to Headquarters Maintenance. There may be instances when the job scope will have to be reduced.

Each year, the Maintenance Program transmits to the Districts allocations of funds for contract maintenance, including any specific restrictions that are included in these allocations. The Districts shall submit their programs to the Maintenance Program for review and filing. Major maintenance projects to be accomplished by State forces will be included in this program but the Districts have the responsibility to provide funding and staffing for this work. Additional projects or changes can be added to the program through the year with notification to the Maintenance Program.

District Directors are responsible to see that roadbed maintenance work is carried out in conformance to the foregoing policies. The Maintenance Program must be made aware of deviations or exceptions.

A.04 Surface Types

The traveled way of the State highway system consists of two basic types for maintenance purposes:

(A) Flexible Type Surfacing (Flexible Roadbed)

Includes all highways with asphalt surfacing and Portland cement concrete with asphaltic concrete surfacing overlay of 2 inches (50.8 millimeters) or more.

Oiled earth, gravel and earth surfaces are also included as flexible type surfacing.

Specifically, flexible pavement is composed of the following types as listed in the California State Highway Log:

Surface Types (Flexible)	
CODE	TYPE
H	With base and surface thickness 7 inches (180 mm.) or more
M	With base and surface less than 7 inches (180 mm) and Oiled Gravel
O	Oiled Earth, Gravel
E.	Earth

(B) Rigid Type Surfacing (Rigid Roadbed).

"A" Family covers maintenance of flexible roadbeds and "B" Family covers rigid roadbeds. Various phases of work involved in these two "families" are described in this Chapter and in Chapter B of this manual.

A.05 Types of Flexible Roadbed Failures

Flexible roadbed may fail by any one or a combination of the following:

- (A) Slippery surface, often caused by excess asphalt combined with dense surface texture.
- (B) Cracking, often due to either brittleness of the asphalt mix, movement in the base, or contraction and expansion due to temperature changes.
- (C) Raveling is generally due to a dry mix or oxidation. However, an excessive amount of moisture can contribute to raveling by washing away the asphalt cement. Freeze-thaw cycles also contribute to raveling.

- (D) Distortion is generally from instability of the mixture, an inadequate base, or both. Distortion will often result when a mixture is too "fat" meaning, there is an excess of asphalt.
- (E) Erosion, due to solvent liquids from an outside source dripping on the pavement surface. This is most often crankcase drippings, particularly on ramps at boulevard stop bars.
- (F) Surface breaks are often a result of a lack of base or support under the pavement surface.
- (G) Stripping is closely related to raveling. The cause of stripping is water separating the asphalt cement from the aggregate.
- (H) Oiled gravel or earth surface failures are generally the result of traffic loads and wind and weather conditions.

A.06 Stockpile Materials for Patching Bituminous Surfacing

Materials for pre-mix, medium-cured (MC) or slow-cured (SC), should be tested by the District Laboratory prior to use if practical. Premix should be stockpiled in the Maintenance station or in rural areas. Storage should be at convenient locations and accessible at all times. Do not stockpile on private property unless necessary written authority is obtained. Avoid locations offering a traffic hazard or where drainage may be disturbed or storm water flows can be affected. Stockpiles should be as inconspicuously placed as possible. Keep stockpiles well squared off and free from weed growth, using herbicides if necessary. Place State Property signs on each stockpile.

Materials required for bituminous surface patching are usually obtainable from the following sources:

- (A) Commercial hot-plants, where plant mix material can be obtained direct from the plant in State-owned or rented trucks for use on the highway or for stockpiling for future use. Where sections of highway are some distance from a hot-plant, stockpiling effects a substantial saving of time by providing asphalt plant mix material where and when it is needed.
- (B) Local material from pits that have been tested by the District Laboratory, or are otherwise, proven suitable for use. These materials can be either mixed at the pit site or hauled to a mixing table for processing. A motor grader is the most commonly used road mixing equipment.

Liquid asphalt for premix may be an MC250, MC800, MC3000, SC250, SC800, or SC3000. The MC type asphalt is a medium curing product, with a solvent similar to kerosene. The SC type is slow curing because its solvent is somewhat like a heavy fuel oil.

Generally speaking, the SC oils are used in the hot desert climates and MC oils are used in the more moderate climates. In many cases, local experiences will dictate the type of oil to be used in manufacturing stockpiled materials for patching bituminous surfacing. Information contained in the Asphalt Institute's various publications can be of some value.

For environmental reasons, MC liquid asphalt is not allowed in some air basins. The cutbacks used for this grade of asphalt give off emissions that are not permitted by the air resources boards in those basins. The county air resources board can provide information regarding local requirements.

A.07 Asphalt Concrete Pavement

Asphalt concrete pavement consists of a mixture of mineral aggregate and bituminous binder (asphalt cement) mixed and spread in accordance with specifications. The gradation of the aggregates varies because of the need of meeting traffic requirements and the availability of aggregate material in any geographical location.

Asphalts are generally grouped within four classifications, including:

- (1) Paving asphalt;
- (2) MC (Medium Curing) liquid asphalt-,
- (3) SC (Slow Curing) liquid asphalt; and
- (4) Various types of emulsions.

Refer to Sections 92, 93 and 94 of the Standard Specifications for complete definitions and descriptions of asphalts and emulsions.

Asphalt concrete mixtures are generally densely graded. This means that the mixture contains very few voids. In some instances, open graded mixtures, that is mixtures that contain more voids than dense graded mixtures, are used for pavement wearing surfaces. These mixtures have the advantage of draining surface water through the void areas. However, they are somewhat susceptible to damage under freeze-thaw conditions. In addition, asphalt-rubber gap graded mixes are being used throughout the State.

For open graded asphalt concrete the bituminous binder for mixing with mineral aggregate may be paving asphalt Grade AR4000 or AR8000 conforming to the Standard Specifications. Climate and experience will indicate which paving asphalt is best for any particular location. In addition, polymer modified and asphalt-rubber binders are available to use for open graded AC.

Difficulties are encountered in hauling open-graded hot asphalt concrete a long distance from a hot-plant as the exterior of the mass tends to chill and the asphalt in the mix drains to the bottom of the truck, which results in an excess of the exterior asphalt in that portion of the load. This also requires frequent cleaning of the truck beds due to the accumulated asphalt.

Best results can be obtained in hauling and spreading open graded asphalt concrete by reducing the mixing temperatures of both the paving asphalt and the mineral aggregate as indicated in Section 39 of the Standard Specifications.

Hot material spreads very easily through the spreader box, but when the mass cools, due to weather or long hauls, considerable difficulty is experienced in securing a satisfactory spread. As a rule, a 30-mile (48.2 kilometer) haul is usually considered the maximum distance which a hot mix can be satisfactorily hauled.

For the technical specifications for asphaltic concrete used in the Department's construction work, refer to the Asphalt Concrete Section of the Standard Specifications.

A.08 Surface Repairs of Oiled Earth, Gravel or Earth Surfaces

Maintenance of oiled earth, gravel or earth surfaces whether in the desert, valley or mountains, is similar and may be done as follows:

- (A) Maintain a crown on the traveled way. This is essential for adequate drainage transverse to the centerline.
- (B) Always attempt to improve drainage of all ditches and culvert outlets.
- (C) Grade protecting dikes or berms on the shoulders of all fill sections, to prevent formation of gullies on slopes. Also provide outlets to discharge pipes to prevent erosion.
- (D) Correct sub-base drainage when surface rolls or distorts. Use perforated metal pipe or rock drains. Locate all depressions during or following a rain and fill with good material. Because of potential cloudbursts in desert areas, numerous drainage outlets must be provided to prevent ponding or scour.
- (E) During regular maintenance grading, always attempt to improve the superelevation in curves.
- (F) If possible, grade after a rain and compact the surface under traffic.
- (G) Dry weather grading may be necessary to provide a smooth surface. Use caution not to cut too deeply or have excess loose material on the surface. Do not leave a windrow of material on the traveled way overnight.

Corrugations in an earth or gravel surface are usually caused by lack of binder in a surface composed principally of rounded coarse aggregate, or a surface predominantly composed of fine material. This condition should be relieved by blading a sufficient depth below the surface to remove the corrugations from the traveled way.

Another method to remove corrugations is by the addition of material with uniform gradation so that when it is compacted, it will retain its shape under normal traffic conditions. Blade the center area first, working outward toward the edges. Potholes should be filled with select material prior to the grading operations.

A.09 Base Repairs

Prior to making surface repairs on any asphalt concrete pavement, determine whether or not the damage was the result of a base failure. If a base failure is evident, decide whether or not the base should be repaired. A surface repair will frequently add sufficient strength to the pavement structural section so that a base repair is not necessary.

Remove all broken material when a base repair is made. Inspect the soil or other material on which the base was laid. Replace poor material as required. Reconstruct the base, preferably with base type asphalt concrete. If this is not practical, reconstruct using whatever good materials may be available. Leave room on the top of the base patch in a suitable thickness to receive the wearing course asphalt pavement.

A.10 Surface Repairs of Flexible Pavement

Surface repairs to flexible pavement vary from very shallow patches tight bladed onto the old surface with a motor grader to pothole patching to a major maintenance overlay. Surface maintenance is not to be confused with resurfacing or reconstruction of an asphalt concrete highway.

Generally, reconstruction or resurfacing will cover several miles (kilometers) of highways. The good portions as well as the poor portions are reconstructed or resurfaced. Major maintenance patching should be done only where the need exists and where a major patch will take the place of a series of small patches.

Asphalt pavement, whether pre-mix or asphalt concrete, will weigh on the average 12 pounds (5.44 kilograms) per one square foot (0.0929 per square meter), 1 inch (25.4 millimeters) thick.

A.11 Pothole and Other Small Patches

Remove all loose material prior to patching potholes. Shape the area evenly with sloping sides to the depth of the patch. The bottom and sides should be primed. For priming, use either liquid asphalt or an emulsified asphalt.

Premix material is then placed in the hole and compacted. Make allowance for compaction that will permit the finished surface of the patch to be flush or just slightly above the surrounding surface. As a general rule, premix asphalt paving material will compact 1/4 inch (6.35 millimeters) for each 1 inch (25.4 millimeters) of loosely placed thickness.

Small patches may be laid directly on top of an asphaltic concrete surface in some instances.

Before this is done, the surface to be patched must be clean and free of any foreign substances.

Apply a tack coat of emulsion to the area to be patched prior to applying the patch material.

Small patches may be laid by hand. On larger patches, it may be more effective to use a motor grader or an asphalt concrete spreading box. Larger patches should be thoroughly rolled. All patches should have squared ends and straight sides for a properly finished appearance.

During periods of cold and inclement weather, potholes can be patched with patented special mixes. The special mixes do not require that the pothole be dry, nor is a prime necessary. Though more expensive than a normal stockpiled premix material, special mixes reduce patching costs because they stay in the potholes much longer.

A.12 Extensive Surface Repairs and Major Maintenance Blankets

A maintenance blanket may be used to make the necessary repairs when pavement failure becomes extensive, over and beyond that requiring pothole or other small patches. Maintenance blankets should be planned in the District's Major Maintenance Program. See this Section A.03 for policy on major maintenance projects.

The surface to receive a blanket should be carefully broomed of all loose material. Prior to placing the blanket, the surface should be tack coated with an asphalt emulsion of RS, CRS, SS or CSS grade. The rate of application should be enough to wet the surface of the old pavement and provide a bond between the new surfacing material and the old one.

A.13 Surface Corrugations

Corrugations and shoving usually occur in asphalt layers that lack stability. Lack of stability may be caused by a mixture that is too rich in asphalt, has too high a proportion of fine aggregate, has coarse or fine aggregate which is too round or too smooth textured, or has asphalt cement which is too soft. It may also be due to excessive moisture, contamination due to oil spillage, or lack of aeration when placing mixes using emulsified or cutback asphalts.

If the corrugated pavement has an aggregate base with a thin surface treatment, a satisfactory corrective measure is to scarify the surface, mix it with the base, and re-compact the mixture before resurfacing.

If the pavement has more than 2 inches (50.8 millimeters) of asphalt surfacing and base, shallow corrugations can be removed with a pavement planing machine. This is followed with a seal coat or plant-mixed surface.

Shoved areas must be removed and patched for effective repair.

A.14 Heat Treatment

In some instances it may be advisable to remove the surface course of asphalt concrete pavement. In other cases, it may be advisable to reduce the quantity of asphalt cement in a pavement surface.

A pavement-planing machine, such as a heater-planer, will accomplish this work by softening the surface so that it may be bladed into a windrow by a motor grader. Heater-planers must be used in accordance with local air pollution control laws or policy.

After removal of a thin asphaltic layer or an asphaltic film with a heater-planer, the remaining surface, may be left as planed if it is in good condition. However, in most cases a new asphalt concrete surface or a seal coat should be applied after a heater-planer job.

Another treatment that should be considered in rural areas to remove excess surface asphalt is the use of an agricultural weed burner. This process has been used successfully and consists of making one pass over the pavement at about 2 to 3 miles (3.21 to 4.82 kilometers) an hour. This is a very economical process to improve skid resistance in appropriate situations. It also must be cleared for air pollution control.

A.15 Seal Coats

Seal coats may be required on asphalt pavement when the pavement shows signs of. (a) raveling or erosion, (b) oxidation, (c) permeable surface, or (d) slipperiness.

A continuous seal should be considered when raveling and checking becomes general or the surface of an asphalt pavement becomes permeable to water. Refer to the Standard Specifications for detailed information on seals. The amount and type of asphalt binder and size of screening selected should be such that maximum temperatures will not cause excessive bleeding, and the completed seal should have a nonskid surface equal or superior to the original surface.

A.16 Preparation Prior to Applying Seal Coats

Prior to, applying a seal coat, correct base failures, and corrugated or distorted surface conditions. Apply seals only on a dry surface (except for fog seal). Sweep the surface clean with power brooms, supplemented, by hand brooming.

Level depressions with premix. This work should be done far enough in advance of the seal coat application to allow for complete curing of the premix. If this is not done, the asphalt will penetrate the uncured premix and will not hold the screenings. Rich spots in the surface to be sealed should be removed, by diskings, heater-planer, or scarifying and re-mixing before the seal is placed.

A.17 Types of Seal Coats

Seal coats commonly used in maintenance work are:

- (A) Fog seals
- (B) Sand seals
- (C) Chip seals
- (D) Slurry seals

The type of seal coat required is usually dictated by field conditions. The four types of seal coats and their applications are described below.

- (A) Fog seals consist of a combination of mixing-type emulsion and 50 percent added water applied at the rate of 1/8 to 1/10 gallon (0.2 to 0.5 liter) per square yard (0.836 per square meter). No cover material is to be applied.
- (B) Sand seals consist of SC-800 or MC-800 liquid asphalt applied at a rate per square yard (square meter) dictated by the condition of surfacing. Cover material can be obtained by using sand from commercial sources or screened material from local pits or streambed, which has been tested by the District Laboratory or otherwise found suitable for use. Do not use sand that contains clay or deleterious material.
- (C) Chip seals consist, in general, of spreading high viscosity asphaltic emulsion with additives followed by spreading rock screenings (chips) in the appropriate rates of application in accordance with the section on seal coats to be found in the Standard Specifications. Sometimes paving grade asphalts with special additives are used in lieu of emulsion for the binder.

On seal coat work the spread rate of emulsion and weight of cover material required will vary somewhat based on the condition of the surface covered, temperature and type of screenings used.

- (D) Slurry seal consists of an application of a mixture of mixing-type asphaltic emulsion, sometimes with additives, mineral aggregate and water, proportioned, mixed and spread on a pavement free of dirt and loose gravel. For complete specifications on slurry seal consult the Standard Specifications.

A17.01 Pavement Rejuvenator

Pavement rejuvenator treatment consists of an application of a rejuvenator material in a procedure similar to a fog seal. This treatment is most effective on dry, porous pavements. The material should be applied well in advance of the fall rains if possible. If it is not possible to apply the material in advance of the fall rains, it should be applied after the rains in the spring.

It is important to run permeability tests on the pavement prior to application of pavement rejuvenator to determine the proper application rate according to the manufacturer's recommendation. The application rate should be based on test results at the most-dense location. If complete penetration of the surface does not occur, apply sand to prevent slippery conditions. Perform tests within one week after the application to check the pavement surface.

A.18 Spreading Cover Material Over Seal Coats

On seal coats where either emulsified asphalt or hot oils are used, do not spread the asphalt too far in advance. Make certain that the cover material is placed at the most opportune time to obtain adhesion.

Mechanical spreaders for sand or screening (chip) cover should be used for a uniform cover and to eliminate surplus cover that is usually lost.

When sand seals are placed, thoroughly broom the area with drag brooms to properly cover all blank spots and provide a uniform texture.

When screenings (chips) are used for cover, one or more power rollers should be used immediately behind the trucks spreading the screenings (chips) to provide initial rolling.

A drag broom should not be used on screening (chip) seal coats, because this could displace or overturn the screenings.

Traffic may be routed over newly laid screenings after they have been rolled but must be restricted to a very slow speed and should be under control until screenings are thoroughly set.

Traffic moving at high speeds on screening seat coat that are not thoroughly set often causes displacement of screenings from the surface, resulting in an over-oiled section which "bleeds" in warm weather. Loose aggregate should be removed by brooming when the asphalt has cured. The first brooming should take place at the end of the first day, just prior to the time when traffic controls are removed for the day. Loose material will have a tendency to loosen additional chip particles under the tires of fast traffic.

A.19 Flexible Pavement Joint and Crack Sealing

Flexible pavement is susceptible to cracking. Cracks are generally attributable to the lack of base support, volume change in the asphalt mix because of temperature changes, and drying of the asphaltic concrete mix. Cracks should be repaired to prevent the entrance of moisture into the sub-grade.

Cracks may be filled with emulsion, emulsion and rejuvenator mixture, or liquid asphalt. Wider cracks may be filled with special asphalt combinations or heavier bodied asphalt material with additives. When using emulsion, light grade liquid asphalts or asphalt rejuvenators for crack repairs, fine sand should be mixed with the liquid or applied to the surface of the crack after it has been filled.

In some instances, cracks should be cleaned prior to filling. A stiff broom may be used for this purpose. Compressed air may also be used, if available. A gouge-type tool or mechanical router can also be used for crack cleaning.

Small cracks, such as alligator-type cracking, may often be repaired, by tacking a blocked-out area and applying chips or other similar material. A thin patch of hot plant mix may also accomplish the same purpose. When using these methods, the seal or patch should be blocked out to give a uniform rectangular appearance.

Slippage cracks are caused by the lack of a good bond between the pavement's surfaced layer and the course beneath. The only proper way to permanently repair a slippage crack is to remove the surface layer to where good bond between the layers is found and then patch the area with plant mixed asphalt concrete.

A.20 Work on Asphalt Shoulders

Due to the hazards of traffic, work on paved asphalt shoulders should be confined to one side of the highway at a time. Workers shall be given protection while working on paved shoulders as outlined in Chapter 8 of this Manual.

A.21 Road Approaches to Public Roads

City or county authorities must obtain permits prior to doing any work on a road approach within the State highway right-of-way.

The following instructions apply to other road approaches to public roads:

- (A) Where State highways connect with county roads and city streets at grade, Caltrans forces will maintain the roadway to the full width of the right-of-way.
- (B) Where the intersections of State highways with county roads and city streets are separated by structures, maintenance is performed as provided in the maintenance agreement with the local authorities.
- (C) When a new road or street approach is to be constructed by city or county authorities, connecting with a State highway, it shall be constructed or improved to meet the standards required for the type and volume of traffic expected.

All public road approaches should be maintained flush with the adjacent shoulder.

Maintenance of freeway interchanges will be in accordance with the freeway maintenance agreements. Superintendents should be furnished a layout sketch showing, in detail those portions of the intersection to be maintained by the State.

A.22 Bicyclists on State Highways

Bicyclists are permitted to travel on State highways, with the exception of certain prohibited sections of freeway. Certain highway improvements and maintenance operations can be detrimental to safe and convenient bicycling unless there is careful consideration of bicyclists' needs.

The following considerations shall be taken into account when planning highway improvements:

- (A) In the placement of maintenance blankets, paved shoulders shall be overlaid, as well as traffic lanes, to prevent creation of a longitudinal step along the right-hand portion of the roadway.
- (B) In the application of seal coats, if the roadway is 26 feet (7.9 meters) or less in width the entire surface should be sealed. For wider roadways, the normal procedure is to seal only the traffic lanes, 24 feet (7.3 meters). However, if the shoulders need sealing, they should be sealed full width to provide a uniform surface.
- (C) Routine roadway maintenance (e.g., repairing deteriorated pavement, roadway excavations, etc.) should be done in such a manner that a uniform surface, free of obstructions, is maintained across the full paved width of roadways, including shoulders. If the right-hand portion of roadways is not properly maintained, bicyclists will find it necessary to ride in traffic lanes, having to share the lanes with motorists.